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Award Number: DAMD17-02-2-0029

TITLE: Mobile Communication Platform

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REPORT DATE: September 2004

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 2004	Annual (15 Aug 03 - 14 Aug 04)

4. TITLE AND SUBTITLE
Mobile Communication Platform

5. FUNDING NUMBERS
DAMD17-02-2-0029

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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 Words)

Hospitals and health clinics located in rural areas often lack the expertise needed to perform various consults and medical examinations. This situation could be improved through the use of telemedicine and communications technologies. However, quite often, these hospitals and clinics lack the financial and technological resources required to construct a permanent telemedicine suite within their facilities. Therefore, CERMUSA proposed the development of the Mobile Communications Platform (MCP) prototype. The main objective of the project is to improve the delivery of healthcare in under-served areas through the creation of a re-locatable telecommunications infrastructure that provides remotely located organizations with the ability to communicate and share information with distant sites. The prototype will utilize existing communications infrastructure to provide services or create its own link to the outside world through satellite technology. Once temporarily installed in the site, the MCP will be used for several purposes including telemedicine consults, information exchange, distributed learning, and emergency communications.

14. SUBJECT TERMS
No subject terms provided.

15. NUMBER OF PAGES
51

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

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Attachment B ..... Robotics Operational Concept Document

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I. Introduction

A. Mobile Communications Platform (MCP) Abstract

Hospitals and health clinics located in rural areas often lack the expertise needed to perform various consults and medical examinations. This situation could be improved through the use of telemedicine and communications technologies. However, quite often, these hospitals and clinics lack the the financial and technological resources required to construct a permanent telemedicine suite within their facilities. Therefore, CERMUSA proposed the development of the Mobile Communications Platform (MCP) prototype. The main objective of the project is to improve the delivery of healthcare in under-served areas through the creation of a re-locatable telecommunications infrastructure that provides remotely located organizations with the ability to communicate and share information with distant sites. The prototype will utilize existing communications infrastructure to provide services or create its own link to the outside world through satellite technology. Once temporarily installed in the site, the MCP will be used for several purposes including telemedicine consults, information exchange, distributed learning, and emergency communications.

B. Robotic Emergency Medicine and Danger-Detection (REMeD-D) Abstract

The Robotic Emergency Medicine and Danger Detection (REMeD-D) prototype will improve the delivery of emergency medical services to individuals in rural areas following an attack facilitated through the use of weapons of mass destruction (WMD). To accomplish its objectives, the REMeD-D prototype will utilize the Mobile Communications Prototype (MCP) as a command and control center that will receive and transmit data from the scene of the emergency situation to distant healthcare facilities. The REMeD-D prototype will utilize robotics and communications technologies to remotely extract victims, assess and monitor the physical condition of those individuals, and transmit the information back to the MCP prototype where it will be sent to a participating medical facility. Through the use of these technologies, first responders, in both civilian and military communities, will be able to remotely extract and transport victims from the effected area to local hospitals and other healthcare facilities without placing themselves in danger of contamination. To facilitate effective communication and education, a nationwide Homeland Security Conference and Exhibition will be held to promote Weapons of Mass Destruction awareness and encourage collaboration between governmental, non-profit, and private industry. As a result, the REMeD-D project will provide the model to follow when developing a system to prepare for and manage emergency situations resulting from a terrorist attack implemented through the use of weapons of mass destruction.

II. Body

A. Mobile Communications Platform (MCP)

1. Task #4 Prototype Analysis and Design

a. Task #4 Prototype Analysis and Design Research Accomplishments

Task #4, Prototype Analysis and Design, provided CERMUSA with the financial and technical expertise required to identify the technological, clinical, and vehicular characteristics of the MCP prototype. Once identified, these characteristics were used to develop three separate prototype design Statement of Work (SOW) documents that could be used to select vendors and services for the prototype construction phase of the project. When combined, these documents created a complete Systems Design Document. This Systems Design Document contains a detailed plan for the construction of a vehicle that is capable of fulfilling the requirements needed to accomplish the research objectives of the MCP project.

The statement of work documents were submitted to several vendors through a formal bidding process. Through the implementation of this process, CERMUSA was able to identify the most appropriate vendors for construction of the MCP prototype. In addition, after the bids were submitted, CERMUSA conducted a cost-benefit analysis to identify the most effective method of deploying the MCP prototype during the test and evaluation phase of the project. For more information please see Task #4 Deliverable: Prototype Analysis and Design submitted September 29, 2003.

Following the development of a detailed Systems Design Document, CERMUSA conducted an in-depth analysis of future prototype implementation. During Task #1, an initial cost-benefit analysis was conducted in an effort to assess the feasibility and cost effectiveness of implementing an MCP prototype. This cost-benefit analysis was created with the most accurate information available at the time.

In an effort to take advantage of the most recent information available, a second cost-benefit analysis was included in the Task #4 research plan. This second cost-benefit analysis was used to create a more accurate estimate of the costs associated with providing healthcare through the use of the future MCP prototype. In addition, this cost analysis also provided a trade-off analysis, describing the potential advantages and disadvantages of providing these medical services through the use of the MCP prototype. The trade-off-analysis, comparing MCP to a stationary telemedicine suite, outlined some of the advantages and disadvantages that would impact an organization's decision to either build a permanent telemedicine suite or utilize a vehicle such as the MCP to deliver healthcare services.

b. Task #4 Prototype Analysis and Design Research Results

The results of research efforts implemented during Task #4 can be found in the statement of work documents as well as the cost-benefit analysis found in Task #4 Deliverable: Prototype Analysis and Design submitted September 29, 2003. The following conclusions were drawn from those research results:

- The MCP will be built on a standard H1 Chassis outfitted with a custom built structure that will be mounted on the back.
- The custom built structure will house several communications technologies that provide the capability of supporting ISDN and satellite communications.
- The telemedicine system will consist of several technologies that will work together seamlessly to provide patient care.
- The MCP must be used among several facilities to justify the cost of construction and implementation.

2. Task #5 Prototype System Build/Prototype/Pilot

The MCP project is currently in Task #5 Prototype System Build/Prototype/Pilot. This phase is the execution of the approved MCP prototype design and, in some cases, may blend into the implementation phase. The MCP prototype is currently under construction and is scheduled to be completed by November of 2004. After construction is complete, a test plan will be carried out to evaluate and document its capabilities. The test plan, presently under development, is scheduled to be completed by November of 2004.

B. Robotic Emergency Medicine and Danger-Detection (REMeD-D)

1. Task #1: Prototype Technology/Programmatic Market Research

a. Task #1: Prototype Technology/Programmatic Market Research Accomplishments

Task #1: Prototype Technology/Programmatic Market Research facilitated the collection of data necessary to identify the technologies, practices, and methods that would be used to carry out the objectives established for the prototype. During this first phase of research, CERMUSA conducted an extensive market analysis that included a comparison study of all organizations, both private and public, that are developing and implementing initiatives similar in scope to the REMeD-D project. After identifying these projects, CERMUSA began to explore the technologies these organizations are employing to carry out their research objectives.

The methodology used to collect data throughout Task #1 involved the integration of two programmatic market research strategies. These strategies were employed in an attempt to access a variety of information sources that could provide an extensive and accurate overview of the technologies that could be used in the REMeD-D project. In addition, information was drawn from the data collected to identify potential research partners.

The accomplishments of research activities performed during Task #1: Prototype Technology/Programmatic Market Research Results can be found in Attachment A: REMeD-D Prototype Technology/Programmatic Market Research Accomplishments.

b. Task #1: Prototype Technology/Programmatic Market Research Results

Throughout Task #1, CERMUSA researched various robotics projects and platforms that could possibly be utilized and/or integrated into the design of the REMeD-D project prototype. In addition, several organizations were identified to begin the process of selecting partners and vendors for the project. This research process consisted of several steps that eventually led to the following conclusions. These conclusions provide a technical description of the future REMeD-D prototype, a list of potential organizations for partnership, and a plan for identifying robotics partners and vendors during Task #2, Prototype Programmatic Needs Assessment.

At the beginning of Task #1 CERMUSA technical staff developed a REMeD-D robotics operational concept document. This document included a comprehensive list of all capabilities and requirements that would potentially be included in the design of a robot that would fit the needs of the REMeD-D project. This document was used as a starting point for all research activities, providing a conceptual guide to researchers when collecting, organizing, and analyzing research results. It also served as an outline for future statement of work documents that would eventually be submitted to various robotics platform and technology integration organizations to build the REMeD-D prototype.

Through a series of meetings, discussions, and continued research activities, the initial technological estimates made for the robotics prototype solidified into a more definite set of requirements. Therefore, CERMUSA modified its original concept document to create the present Robotics Operational Concept document found in Attachment B: REMeD-D Robotics Operational Concept Document.

2. Task #2: Prototype Programmatic Needs Assessment

a. Task #2: Prototype Programmatic Needs Assessment Research Accomplishments

Several organizations were identified as being the most likely to serve as effective research partners and/or robotics technology vendors throughout the REMeD-D project. These organizations were categorized into three main groups including governmental organizations, research and educational institutions, and private corporations and vendors. During Task #2, CERMUSA further researched these organizations through a series of organizational site visits and technology conferences.

- Governmental Organizations – The development of governmental research partners provided CERMUSA with insight into the needs of the Department of Defense and other public organizations that may benefit from the research. This

insight allowed CERMUSA to create a robotics prototype concept capable of serving those needs.

- Research and Educational Institutions - The development of partnerships with research and educational institutions allowed CERMUSA to learn from research that has already been conducted in the field of robotics. In addition, this research partner provided assistance in the development of a robotics statement of work document and the selection of robotics platform and technology integration vendors.

- Private Corporations and Vendors – The establishment of relationships with private robotics technology corporations and vendors provided CERMUSA with the technical expertise needed to develop a robotics platform and technology integration package capable of accomplishing the objectives of the REMeD-D project. These vendors were selected through a partnership research process guided by the Telemedicine and Advanced Technology Research Center (TATRC).

b. Task #2: Prototype Programmatic Needs Assessment Research Results

As a result of the research performed during the first two tasks of the project, CERMUSA, with the assistance of TATRC, was able to develop a project plan of implementation. Through a series of partnerships, several robotics engineering, software development, and research organizations will work with CERMUSA to accomplish the objectives of the REMeD-D project. During Task #3, Prototype Build, these partnerships will provide CERMUSA with the expertise, experience, and technological knowledge required to design and construct two robotics prototypes. A detailed description of this plan can be found in Attachment C: Robotic Emergency Medicine and Danger-Detection (REMeD-D) Project Implementation Plan.

III. Key Research Accomplishments

- Development of a detailed Systems Design Document used to select vendors and services for the prototype construction phase of the project,
- Conducted a second cost-benefit analysis to create a more accurate estimate of the costs associated with providing healthcare through the use of the future MCP prototype,
- Conducted an extensive market analysis to identify the technologies, practices, and methods that would be used to carry out the objectives established for the REMeD-D project,
- Development of a REMeD-D robotics operational concept document,
- Identification of REMeD-D project partners along with the creation of a REMeD-D project implementation plan.

IV. Reportable Outcomes

A. Deliverables

1. Mobile Communications Platform (MCP)

a. Task #4 MCP Prototype/Project Definition - Submitted September 29, 2003

B. Presentations

Laratonda, A.: "Mobile Communications Platform (MCP)", American Telemedicine Association Meeting and Exposition, Tampa, Florida, May 2-5, 2004.

Laratonda, A.: "Robotic Emergency Medicine and Danger-Detection (REMeD-D)", American Telemedicine Association Meeting and Exposition, Tampa, Florida, May 2-5, 2004.

V. Conclusions

A. Project Importance and Implications

Initial research results suggest that the construction of an MCP prototype would improve the delivery of healthcare and communications services in rural areas, while serving as a valuable research and development resource for the U.S. Armed Forces. The proper application of an effective MCP research plan has the potential to provide results related to several important fields of study. A well designed research prototype platform could serve several important purposes including emergency medical service support, rural healthcare delivery, and homeland security enhancement.

The MCP prototype could be used as a military research and development prototype to evaluate new technologies while also serving the eudcational and healthcare needs of individuals in remote and medically under-served areas. Serving as a research prototype, the MCP could be utilized to evaluate several forms of mobile communications and telemedicine technologies before they are implemented on the battlefield. While being used as an operational prototype, the MCP could provide civilians in rural areas with greater access to services such as public health screenings, continuing education courses, and physical examinations.

In addition, while being used in conjunction with other research prototypes, such as the REMeD-D project, the MCP could improve homeland security and medical services during natural disasters and other emergency situations. The MCP's robust communications infrastructure could be utilized to establish a temporary communications link that would allow healthcare personnel at distant hospitals to communicate with individuals at the the scene of the incident. This communication has the potential to improve emergency medical services during rural Weapons of Mass Destruction (WMD) attacks. This enhanced system of public defense will compliment the actions that are

being taken in more urban areas of the country, providing a safe refuge for victims of terrorism attacks in more populated areas.

B. Potential Problems and Recommendations

Throughout the past year, the research processes outlined in this annual report have had a tremendous impact on the development, implementation, and execution of the MCP and REMeD-D task deliverables. A significant stage in the development of every research project is the task of identifying the most appropriate research methods, resources, and organizational partnerships that can be utilized to accomplish the objectives established for the project. In an effort to utilize resources in the most efficient and effective manner possible, CERMUSA and TATRC have collaborated to ensure that all possible alternatives have been explored and considered before making important decisions concerning the direction of the projects. This exhaustive process has necessitated adjustments to the project timeline originally submitted for both the MCP and REMeD-D projects. However, in the interest of conducting responsible "due diligence" both CERMUSA and TATRC believe that this project implementation schedule adjustment will result in a responsible and organizationally sound testing and evaluation phase. The results of that testing and evaluation phase will build a solid base from which newer research projects and programs can be developed.

Attachment A
REMeD-D Prototype Technology/Programmatic Market Research Accomplishments

I. Research Methodology

The methodology used to collect data throughout Task #1 involved the integration of two programmatic market research strategies. These strategies were employed in an attempt to access a variety of information sources that could provide an extensive and accurate overview of the technologies that could be used in the REMeD-D project. In addition, information could be drawn from the data collected to identify potential research partners.

A. Internet Research Methodology

Initial research activities began with an investigation into information resources available to the general public on the Internet. The first step in collecting the data involved identifying research institutions and commercial vendors with the potential to assist CERMUSA in the development of a REMeD-D prototype. To identify and collect this online information, CERMUSA utilized a combination of several online search engines.

Through the use of these search engines, CERMUSA conducted an extensive broad search session of sites available for public access. This search session involved conducting several online key term searches. The search terms involved in this broad search session, listed below, were identified by CERMUSA's REMeD-D project team as being the most likely to return favorable results. All relevant results drawn from this initial search session were printed, read, and screened to identify new search terms that would potentially produce more data related to the goals of the REMeD-D project. The following terms were used during several Internet searches conducted between the months of October and December 2003.

- search and rescue
- search and rescue robotics
- robotics
- weapons of mass destruction
- unmanned ground vehicles
- unmanned vehicles
- homeland security
- wireless sensors

Following the initial broad search session, described above, several additional Internet search sessions were performed. The searches performed during these sessions included key terms such as organizations, technologies, and projects identified during the first search session. Terms taken from the following categories of information were included in the secondary search sessions. These categories were created through a careful analysis of the results derived from the initial search session. The resulting bibliography of complete search results can be found in Appendix A: Internet Programmatic Market Research Results.

- Organizations involved in the fields of robotics and homeland security
- Robotics technologies utilized by the organizations
- Projects and programs similar in scope to the REMeD-D project

B. Database Research Methodology

The second programmatic market research strategy employed during Task #1 involved the identification, selection, and utilization of several advanced technology information databases. These databases, accessed online through the Thomson Dialog Database Information Clearinghouse, contain articles and abstracts from thousands of scientific and technical research reports, publications, dissertations, and conference papers.

Dialog's Database Clearinghouse contains 900 databases providing global coverage of a variety of topics related to business, technology, and other professional fields of study. Therefore, when planning a productive research plan, CERMUSA's REMeD-D project team concluded that they should limit their search strategy to a few specific databases. To begin the research process, the team selected the top 15 databases returning the most relevant information related to the field of robotics technology. To identify these databases, the team conducted a broad search of all 900 Dialog databases found within the clearinghouse. The word 'robot' was used as the primary search term when gathering information. The results of this broad search indicated that, out of all 900 databases, the following 15 databases contained the most relevant information related to the topic of robotics. All data collected through this process was analyzed and organized into the bibliographic format found in Appendix B: Technological Database Research Results.

- INSPEC
- NTIS - National Technical Information Service
- Ei Compendex
- ABI/INFORM
- Gale Group PROMT
- Inside Conferences
- Wilson Applied Science & Technology Abstracts
- Gale Group Trade & Industry Database
- MEDLINE
- Federal Register
- FEDERAL RESEARCH IN PROGRESS
- Investext
- Wilson Business Abstracts Full Text
- Jane's Defense & Aerospace News/Analysis
- Gale Group Newsletter Database

II. Research Results

The results of Task #1 provided CERMUSA with the information needed to begin contacting potential robotics partners and vendors to discuss the possibility of collaboration. The collection of this data was implemented through two separate but related programmatic market research strategies. These strategies provided CERMUSA with the background needed to identify potential research partners, draft an initial robotics operational concept, and develop a base of knowledge that could be used as a resource throughout the implementation of the project. The programmatic research strategies included in the implementation of Task #1 included:

Attachment A
REMeD-D Prototype Technology/Programmatic Market Research Accomplishments

1. Internet Research
2. Technological Database Research

A. Internet Research Results

The results of the Internet Research strategy, found in Attachment A, can be separated into several categories. The information found in these categories is listed by organization name, title of article (where applicable), and URL address where the information can be found online. The categories consist of the following topics:

1. Robotics Research Organizations - Organizations, consisting of educational institutions and non-profit entities, conducting research related to the field of robotics and robotics applications and peripherals. Throughout the project, one or more of these organizations may serve as a research partner, providing professional guidance in areas where CERMUSA may need additional technical expertise and advice.

2. Robotics Commercial Development and Application Organizations - Organizations developing commercial products related to the field of robotics. Throughout the project, CERMUSA will be utilizing the services of one or more of these organizations to develop and build the robotics, communications, and sensing technologies needed to accomplish the objectives of the REMeD-D project. These organizations will be selected, through a formal bidding process, based on pricing, expertise, and professional reputation and ability.

3. Robotics Research Background Information - Articles, research studies, and other informational resources providing background information related to the field or robotics technology. This information will be used throughout the research process to select appropriate technologies, assess research results, and enhance CERMUSA's ability to develop a prototype capable of serving the needs of both the military and remote and rural areas.

B. Technological Database Research Results

The results of the Technological Database Research strategy, found in Attachment B, can be separated into several categories. The information found in these categories is listed by file number, database name, article accession number, title of article, and year of publication. Each database found in the Dialog Database Clearinghouse is assigned a unique file number. This number is listed first, followed by the name of the database and the article accession number. The article accession number uniquely identifies each article found in the database. Upon accessing the Clearinghouse resources a user can locate each article through the use of the database file number and the article accession number. The categories established for the Technological Database Research results consist of the following topics:

Attachment A
REMeD-D Prototype Technology/Programmatic Market Research Accomplishments

1. Communication Technology - Articles, research studies, and other informational resources describing technologies that could be used to facilitate communications during the operation of the REMeD-D robotics prototype.

2. Industrial Trends and Consumer Products Applications - Articles, research studies, and other informational resources describing robotics related products and services that are presently being developed produced for use in the public and private sector. These articles may also contain information summarizing present industrial trends while also discussing the future of the industry.

3. Military Applications - Articles, research studies, and other informational resources describing the use of robotics technologies in the United States Armed Forces.

4. Navigation Technology - Articles, research studies, and other informational resources describing technologies that could be used to enhance the navigational capabilities of the REMeD-D robotics prototype.

5. Search and Rescue Applications - Articles, research studies, and other informational resources describing the application of robotics technologies to sear and rescue operations. These operations may include searching for casualties and/or rescuing victims of natural disasters, weapons or mass destruction incidents, and chemical spills.

6. Sensing Technology - Articles, research studies, and other informational resources describing technologies that could be used to enhance the environmental sensing capabilities of the REMeD-D robotics prototype.

Appendix A
Internet Programmatic Market Research Results

Robotics Research Organizations

Applied Perception. http://www.appliedperception.com

Carnegie Mellon University Robotics Institute. http://www.cmu.edu.

Center for Robot Assisted Search and Rescue. http://crasar.csee.usf.edu

Columbia University Robotics Group. http://www1.cs.columbia.edu/robotics/

Drexel University College of Information Science and Technology.
http://www.cis.drexel.edu/

Harvard Robotics Laboratory. http://hrl.harvard.edu/

Henry Samueli School of Engineering and Applied Science.
http://www.engineer.ucla.edu/

IEEE Robotics and Automation Society. http://www.service-robots.org

Joint Robotics Program. http://www.jointrobotics.com/

Lawrence Livermore National Laboratory. http://www.llnl.gov

Massachusetts Institute of Technology Humanoid Robotics Group.
http://www.ai.mit.edu/projects/humanoid-robotics-group/

Mitre. http://www.mitre.org

National Institute of Standards and Technology (NIST). http://www.nist.gov

NAVSEA. http://www.dt.navy.mil

Redstone Arsenal, Alabama. http://www.redstone.army.mil

Robotics Foundry. http://www.roboticsfoundry.org/faq.html

Sandia National Laboratories. http://www.sandia.gov

Space and Naval Warfare Systems Command (SPAWAR). http://www.spawar.navy.mil

Stanford AI Laboratory. http://robotics.stanford.edu/

Tank Automotive and Armaments Command. http://www.tacom.army.mil

Tulane University. http://www.som.tulane.edu

Appendix A
Internet Programmatic Market Research Results

University of Southern California Center for Robotics and Embedded Systems (CRES). http://www-robotics.usc.edu/

Ultra Wideband Working Group. http://www.uwb.org

Robotics Commercial Development and Application Organizations

Aether Wire and Location, Inc. http://www.aetherwire.com

Arrick Robotics. http://www.robotics.com

Cyrano Sciences, Inc. http://cyranosciences.com

Foster Miller, Inc. http://www.foster-miller.com

FANUC Robotics America, Inc. http://www.fanucrobotics.com

Gecko Systems Inc. http://www.geckosystems.com

Honda. http://www.hondacorporate.com

Inuktun. http://www.inuktun.com

iRobot. http://www.irobot.com/home/default.asp

LifeWave, Inc. http://www.lifewaveinc.com

Lockheed Martin. http://www.lockheedmartin.com

McEwan Technologies, Inc. http://www.mcewantechnologies.com

Multispectral Solutions, Inc. http://www.multispectral.com

Omnitech Robotics International. http://www.omnitech.com

Pulse-Link. http://www.pulselink.net

RedZone Robotics. http://www.redzone.com

Remotec, Inc. http://www.remotec-andros.com

Robotic Industries Association. http://www.roboticsonline.com/

Rod Millen. http://www.rodmillen.com/

Appendix A
Internet Programmatic Market Research Results

Time Domain. http://www.timedomain.com

Wisair. http://www.wisair.com/

Robotics Research Background Information

Center for Robot Assisted Search and Rescue (CRASAR). *Rescue robot demonstrated for mine disaster*. http://crasar.csee.usf.edu/MainFiles/july18_03.htm. July 18, 2003.

Center for Robot Assisted Search and Rescue (CRASAR). *Rescue robots get medical sensors*. http://crasar.csee.usf.edu/MainFiles/aug26_02.htm. August 26, 2002.

Center for Robot Assisted Search and Rescue (CRASAR). *Robots to the rescue*. http://sptimes.com/2003/03/02/Floridian/Robots_to_the_rescue.shtml. March 2, 2003.

Cyrano Sciences. *Electronic noses and how they help in our society*. http://ed.tsud.edu/tcubed/cool_tech/electronic_noses.htm. November 1999.

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Foster Miller, Inc. *Man-portable robots for EOD, reconnaissance, communication, sensing, security and rescue*. http://www.foster-miller.com/lemming.htm.

Gecko Systems. *Mobile robotic solutions: SecurityBot*^{TM}. http://www.geckosystems.com/SecurityBot/.

Honda. *Meet ASIMO, Honda's humanoid robot*. http://www.hondacorporate.com/new/?subsection=asimo.

IEEE. *Search and rescue robots*. http://www.service-robots.org/searchRobots.php.

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Lockheed Martin. *Long-lasting colonies: workshop on revolutionary aerospace system concepts for human/robotic exploration of the solar system*. http://www.icase.edu/workshops/hress01/presentations/chun.pdf. November 6, 2001.

Appendix A
Internet Programmatic Market Research Results

Mitre. *Designing robot teams for military use.* http://www.mitre.org/news/digest/advanced_research/02_03/ar_robotics.html. February 2003.

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National Robotics Engineering Consortium. *Dragon runner™.* http://www.rec.ri.cmu.edu/projects/dragon/dragon.shtml. November 12, 2002.

NAVSEA. *Unmanned vehicles – a technology whose time has come.* http://www.dt.navy.mil/pao/excerpts%20pages/2001/unmannedV7_01.htm. July 2001.

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Pacific Northwest National Laboratory (PNNL). *Electronic noses and their applications.* http://cns-web.bu.edu/pub/laliden/WWW/Papers/nose.html. October 12, 1995.

Rafael. *RAFAEL unveil new tactical UAV.* http://www.uvonline.com/cgi-bin/view?t=N&r=N/1478. May 6, 2003.

Redstone Arsenal, Alabama. *Man-portable robotic systems (MPRS).* http://www.redstone.army.mil/ugvsjpo/MPRS_PROGRAM_MAINPAGE.htm.

Redstone Arsenal, Alabama. *Standardized robotic system (SRS) program.* http://www.redstone.army.mil/ugvsjpo/SRS_MAINPAGE.htm.

Appendix A
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Attachment B
Robotics Operational Concept Document

Introduction

The Robotic Emergency Medicine and Danger-Detection (REMeD-D) prototype will be developed through a collaborative effort involving CERMUSA and several other organizations. Each organization will play a role in the development of the prototype. These organizations will build two robots capable of working together to accomplish the following objectives established for Task #8 of the Mobile Communications Platform (MCP) project:

- Remotely extract victims injured as a result of a weapons of mass destruction attack
- Remotely assess the physical condition of victims injured as a result of a weapons of mass destruction attack
- Share the information gained from these activities with local military and civilian authorities located in rural areas

When needed, telemedicine prototype developers may be included in the process to provide healthcare consulting services. Through the implementation of background market research, request for information results, and internal planning, CERMUSA has developed the following operational concept for the development of a REMeD-D robotics prototype.

Robotics Platform and Operation

Two robots will be utilized to accomplish the objectives of the project. These two robots will include an extraction robot, estimated to be about the size of an all terrain vehicle, and a smaller assessment robot, estimated to be about the size of a standard briefcase. The first robot will be the "assessment" robot. It will be stored and deployed from a cargo hold area within the "extraction" robot's protective armor. The "assessment" robot will embark from the "extraction" robot to evaluate the environment and locate injured individuals.

Upon arriving at the scene of the disaster and/or bioterrorism attack, the combined robots will be deployed from a security trailer. The "extraction" robot with the "assessment" robot within its shell will be guided via remote control technologies to a tactical position near the MCP Command and Control Vehicle to be used as wireless communications repeater, extending the effective range of the wireless communications. Next the "assessment" robot will be deployed.

The "assessment" robot will contain sensors to evaluate the quality of the air, cameras to provide video data, technologies to assess the condition of the individual, and possibly infrared or ultra wide band technologies that will allow it to essentially "see through" brush and other debris. After it has collected data from the environment, the assessment robot will then transmit information, through wireless technologies, to the extraction robot and/or the Mobile Communications Platform (MCP) Command and Control Center. Depending upon terrain, distance, and other environmental factors, this information may, or may not, be transmitted by the assessment robot, directly to the MCP. During operation, this information may be transmitted to the extraction robot, located somewhere between the MCP and the assessment robot, where it will then be relayed to the MCP command and control center. All environmental information and navigational data exchanged between all entities involved in the project will have the capability of being transmitted over a variety of wireless communications frequencies

and modalities. Therefore, during the study, satellite, 802.11, UHF, and VHF frequencies, among others, will be evaluated as a means of robot and MCP communications. In addition, depending upon environmental conditions and the capabilities of these wireless technologies, the quality of data, such as video information, will vary. For instance, in some cases, real time video may be transmitted while at other times still shots of patients and the environmental conditions may be the only form of visual information available.

The extraction robot, estimated to be the size of a four wheel all terrain vehicle, will be used to extract the patient after the assessment robot has located the individual and assessed whether or not their physical condition is favorable enough to warrant an attempted extraction and rescue. After receiving information from the assessment robot, the extraction robot will transmit information to the MCP, when needed, and navigate its way to the location of the injured individual. During operation, the extraction robot may be controlled and operated in two ways. First, it may be able to navigate its way to the injured individual, without human intervention, through the use of information received from the assessment robot. Second, it may be driven manually, through the use of remote control technologies, to the site of the injured person. Upon arrival, the extraction robot will then load the person onto the patient transport platform and carry them back to the MCP command and control center. This may be done with the aid of the injured individual and/or through the exclusive use of remote control technologies without human intervention. To accomplish these objectives effectively, the robots will perform the following functions:

Environmental Assessment

Minimum Requirements:

- The detection of gases and/or airborne particles that may be hazardous to human health
- The use of video monitoring to provide operators with visual information regarding the scene of the emergency and the condition of injured individuals

Options to consider if technology and funding constraints allow:

- The detection of airborne pathogens that may be hazardous to human health
- The evaluation of water quality where needed
- The use of ultra wide band and/or infrared technology for detection of objects hidden from sight
- Audio monitoring equipment

Medical Assessment

Minimum Requirements:

- Evaluate a person to determine if they are alive before transport
- The use of video monitoring to provide operators with visual information regarding the scene of the emergency and the condition of injured individuals

Options to consider if technology and funding constraints allow:

- Detect patient heart rate

- Detect patient pulse oximetry
- Detect patient body temperature
- Audio monitoring equipment

Patient Transport

Minimum Requirements:

- Safely extract a patient from the field and transport them back to the command and control center with little physical human intervention during the process

Options to consider if technology and funding constraints allow:

- Provide the patient with protection from enemy fire during transport
- Pick the patient up and place him or her on the transport platform without physical human intervention

Attachment C
Robotic Emergency Medicine and Danger-Detection (REMeD-D)
Project Implementation Plan

Organizational Roles

The following chart describes the organizational roles:

Organization	Responsibility
1. TATRC	• TATRC oversees the entire project to ensure that all players are working together and fulfilling their roles. • TATRC is the ultimate source of all project funding. • TATRC provides Irobot with $150,000 dollars to purchase two Packbot Platforms. • TATRC provides funding to Foster Miller, Inc. to develop the patient extraction tool. • TATRC provides funding to CERMUSA to carry out the research objectives of REMeD-D project. • TATRC researches and purchases the chemical and biological sensing technologies required to assess environmental conditions.
2. CERMUSA	• CERMUSA purchases the extraction robot platform. • CERMUSA compensates Applied Perception for all robotics integration costs associated with the development of the extraction and assessment robots. • CERMUSA researches and purchases the medical and physiological sensing technologies required to assess the physical condition of patients. • CERMUSA develops a test plan and evaluates both robotics prototypes in a rural environment.
3. Applied Perception	Applied Perception provides robotics consulting services to CERMUSA. Their responsibilities will include: • Integrating the Foster-Miller extraction tool with the extraction robot platform. (Developing the mechanism that will load the stretcher onto the robotics platform after the patient has been secured.) • Outfitting the assessment robot with biological, chemical, and physiological sensors provided by both TATRC and CERMUSA. • Integrating the two robotics communications/robotics platforms to ensure that they work together efficiently and effectively.
4. Foster-Miller, Inc.	• Foster Miller, Inc. designs and constructs an extraction tool that is capable of picking up and securing a patient for extraction. • Foster Miller, Inc. works with Applied Perception to integrate the extraction tool with the extraction robot platform.
5. Irobot	• Irobot provides two Packbot robotics platforms for use as assessment prototypes. The platforms will be outfitted identically, each possessing the same features and technologies. After the test and evaluation phase, CERMUSA will keep one of the Packbots and TATRC will keep the other. • Irobot works with Applied Perception to outfit Packbots with chemical and biological sensing technologies.

Attachment C
Robotic Emergency Medicine and Danger-Detection (REMeD-D)
Project Implementation Plan

Robotic Emergency Medicine and Danger-Detection (REMeD-D)
Project Plan Responsibility Flow Chart